Calculus 1 Workbook

Tangent and normal lines

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MATH

TANGENT LINES

■ 1. Find the equation of the tangent line to the graph of the equation at $(1/2,\pi)$.

$f(x) = 4\arctan 2x$

■ 2. Find the equation of the tangent line to the graph of the equation at $(-1,-9)$.

$g(x) = x^3 - 2x^2 + x - 5$

■ 3. Find the equation of the tangent line to the graph of the equation at $(0,-4)$.

$h(x) = -4e^{-x} + 3x$

■ 4. Find the equation of the tangent line to the graph of the equation at $(1,1)$.

$f(x) = -6x^4 + 4x^3 - 3x^2 + 5x + 1$

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VALUE THAT MAKES TWO TANGENT LINES PARALLEL

■ 1. Find the value of a such that the tangent lines to $f(x) = 2x^3 + 2$ at $x = a$ and $x = a + 1$ are parallel.

■ 2. Find the value of a such that the tangent lines to $g(x) = x^3 + x^2 + 7$ at $x = a$ and $x = a + 1$ are parallel.

■ 3. Find the value of a such that the tangent lines to $h(x) = \tan^{-1} x$ at $x = a$ and $x = a + 1$ are parallel.

■ 4. Find the value of a such that the tangent lines to $f(x) = 4x^3 - 6x + 7$ at $x = a$ and $x = a + 1$ are parallel.

■ 5. Find the value of a such that the tangent lines to $g(x) = (x - 2)^3 + x^2 + 3$ at $x = a$ and $x = a + 1$ are parallel.

■ 6. Find the approximate value of a, rounded to the nearest hundredth, such that the tangent lines to $h(x) = e^x - 3x^2$ at $x = a$ and $x = a + 1$ are parallel.

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VALUES THAT MAKE THE FUNCTION DIFFERENTIABLE

■ 1. What value of a and b will make the function differentiable?

$$f(x) = \begin{cases} x^2 & \text{if} \quad x \leq 3 \\ ax - b & \text{if} \quad x > 3 \end{cases}$$

■ 2. What value of a and b will make the function differentiable?

$$g(x) = \begin{cases} ax + b & \text{if} \quad x \leq -1 \\ bx^2 - 1 & \text{if} \quad x > -1 \end{cases}$$

■ 3. What value of a and b will make the function differentiable?

$$h(x) = \begin{cases} ax^3 & \text{if} \quad x \leq 2 \\ x^2 - b & \text{if} \quad x > 2 \end{cases}$$

■ 4. What value of a and b will make the function differentiable?

$$f(x) = \begin{cases} 3 - x & \text{if} \quad x \leq 1 \\ ax^2 - bx & \text{if} \quad x > 1 \end{cases}$$

■ 5. What value of a and b will make the function differentiable?

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$$g(x) = \begin{cases} x^3 & \text{if} \quad x \leq 1 \\ a(x-2)^2 - b & \text{if} \quad x > 1 \end{cases}$$

■ 6. What value of a and b will make the function differentiable?

$$h(x) = \begin{cases} ax^2 + b & \text{if} \quad x \leq 3 \\ bx + 4 & \text{if} \quad x > 3 \end{cases}$$

■ 7. What value of a and b will make the function differentiable?

$$f(x) = \begin{cases} ax^2 + 10 & \text{if} \quad x \leq 2 \\ x^2 - 6x + b & \text{if} \quad x > 2 \end{cases}$$

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HORIZONTAL AND VERTICAL TANGENT LINES AND DIFFERENTIABILITY

■ 1. Find the equation of the vertical tangent line in the interval $[2,6]$.

$f(x) = 2\sqrt[3]{x-4} + 2$

■ 2. Find the equation of the horizontal tangent line in the interval $[2,4]$.

$g(x) = \frac{3}{2}(x-2)^3 - 2x + 3$

■ 3. Find the equation of the horizontal and vertical tangent lines in the interval $[-2,2]$.

$h(x) = \frac{x^3}{3-x^2} + 1$

■ 4. Find the equation of the horizontal tangent line in the interval $[-2,3]$.

$f(x) = 3x^2 - 6x - 4$

■ 5. Find the equation of the vertical tangent line in the interval $[3,6]$.

$g(x) = \sqrt{3(x-3)^2 - 3}$

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NORMAL LINES

■ 1. Find the equation of the normal line to the graph of $f(x) = 5x^4 + 3e^x$ at $(0,3)$.

■ 2. Find the equation of the normal line to the graph of $g(x) = \ln e^{4x} + 2x^3$ at $(2,24)$.

■ 3. Find the equation of the normal line to the graph of $h(x) = 5\cos x + 5\sin x$ at $(\pi/2,5)$.

■ 4. Find the equation of the normal line to the graph of $f(x) = 7x^3 + 2x^2 - 5x + 9$ at $(2,63)$.

■ 5. Find the equation of the normal line to the graph of $g(x) = 5\sqrt{x^2 - 14x + 49}$ at $(2,25)$.

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AVERAGE RATE OF CHANGE

■ 1. Find the average rate of change of the function over the interval $[4,9]$.

$$f(x) = \frac{5\sqrt{x} - 2}{3}$$

■ 2. Find the average rate of change of the function over the interval $[16,25]$.

$$g(x) = \frac{2x - 8}{\sqrt{x} - 2}$$

■ 3. Find the average rate of change of the function over the interval $[0,4]$.

$$h(x) = \frac{x^3 - 8}{x^2 - 4x - 5}$$

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